

## **Characterizing Tropical Vegetation Canopies Using Multi-Frequency Interferometry and Polarimetry**

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SAR Interferometry has proved to be a valuable tool for topographic mapping and change detection. In the last few years, some studies have examined the possibility of using SAR Interferometry to characterize vegetation canopies, especially tree height and canopy penetration. This characterization is feasible since it has been shown by various authors that volumetric scattering introduces decorrelation between the interferometric channels, thus establishing a causal relationship between the tree geometry and the interferometric signal.

It is expected that vegetation type, and the detailed nature of the canopy gap structure play a major influence in the amount of penetration into the canopy. Previous studies have concentrated in coniferous or deciduous tree stands, where the canopy geometry allowed for large gaps. Past data analysis has also concentrated on C or X-band interferometric returns. It is the purpose of this study to present the results of an experiment conducted to characterize interferometric returns at C and L-bands for tropical vegetation canopies. During the late fall of 1996, the NASA/JPL TOPSAR system collected C and L-band interferometric, as well as P-band polarimetric, data in Cape York, Australia. Ground truth vegetation observations were also collected, and in this paper we present the results of dual frequency height and penetration measurements into various tropical vegetation types, including rain forest, mangroves, and various types of eucalyptus woodlands. The measurement of estimated tree height and height biases inferred from decorrelation data are examined, and the feasibility of using IFSAR's for tree height measurements in tropical forests is assessed.

In addition to measurements of tree height, interferometric data can be used to perform terrain classification for different tree types. We present a tree type classification scheme which uses single or multiple frequency interferometric data, as well as mixed interferometric and P-band polarimetric data, for the identification of different vegetation types. The accuracy of the classification algorithm is assessed by comparing against ground truth data collected by the Queensland Arboretum in support of the CYPLUS project. The relative advantages of classification at various frequencies and using various channel combinations is assessed. The implications of these results for performing terrain classification using data from the forthcoming NIMA/NASA Shuttle Radar Topography Mission (SRTM) is also examined.